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AN ANALYSIS OF THE UNITED STATES  
AIR FORCE NONPOINT SOURCE WATER  
POLLUTION ABATEMENT PROGRAM

THESIS

Terry G. Seaman  
Captain, USAF

AFIT/GEM/DEM/90S-16

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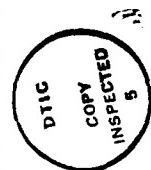
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**AFIT/GEM/DEM/90S-16**

**AN ANALYSIS OF THE UNITED STATES AIR FORCE  
NONPOINT SOURCE WATER POLLUTION ABATEMENT PROGRAM**

**Presented to the Faculty of the School of Systems and Logistics  
of the Air Force Institute of Technology  
Air University  
In Partial Fulfillment of the Degree of  
Masters of Science in Engineering Management**

**Terry G. Seaman, B.S.C.E.  
Captain, USAF**

**September 1990**

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### Preface

The purpose of this study was to analyze the Air Force nonpoint source pollution abatement program. A review of the current implementation levels for 72 installations indicated that significant inter- and intra-command differences exist for individual installation implementation. The study concluded that this most the result of the widely diverse nonpoint source pollution management programs in the various states.

In conducting this research and writing its report of findings, I have greatly benefited from the advice and guidance of others. I am deeply indebted to my thesis advisor, Major Russ Burcher, for his enthusiastic support, timely feedback, and sound advice which served to guide me along the research path. I also owe a heartfelt thanks to my thesis reader, Lieutenant Colonel Mark Goltz, for his infallible ability to catch erroneous and ambiguous statements within the thesis text. Most importantly, I wish to express a special thanks to my wife, Ginny, and my son, Ryan, for their love, support and understanding during the many long days and nights which were spent conducting, analyzing and reporting this thesis research.

Terry G. Seaman

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Abstract

This research examined the Air Force nonpoint source pollution abatement program by evaluating Major Command, Air Force Regional Civil Engineer and installation compliance to the official Air Force policy. Seventy-two installations in 37 states and ten Major Commands were represented in the data. The evaluation classified nonpoint source pollutants into five categories: urban, agricultural, construction, silvicultural and other.

The research showed that most of the Major Command abatement programs were adequately meeting the needs of the Air Force. Two Air Force Regional Civil Engineers were evaluated. It was determined that one of these organizations had taken the necessary steps to implement nonpoint source abatement at the installations within their jurisdiction. The other organization was found to have a lack of current state regulatory information. Installation compliance was inconclusive due to the ambiguous, unstructured nature of the data.

The major conclusion of this study was the need for the Air Force installations to implement more comprehensive nonpoint source pollution abatement programs. Elements of these programs range from educating the installations' populaces to implementing nonstructural best management practices such as including nonpoint source pollution abatement in Natural Resources Plans.

# AN ANALYSIS OF THE UNITED STATES AIR FORCE NONPOINT SOURCE WATER POLLUTION ABATEMENT PROGRAM

## I. Introduction

### Overview

This chapter provides background information on nonpoint source water pollution, a definition of nonpoint source water pollution, the problem statement of this study, its purpose and justification, the specific objectives, and the scope of the study's application.

### Nonpoint Source Pollution Definition

Water pollution refers to an undesirable change in the quality of water. This pollution is classified by the method by which it enters a watercourse. Point sources are easy to identify, since they are usually continuous and enter the environment at discrete points. Effluents from industrial and municipal sewage treatment plants fall into this category (Chesters and Schierow, 1985:9).

Nonpoint source pollution is more difficult to isolate and control. It enters the environment from diffuse sources that may be land-based or airborne (Chesters and Schierow, 1985:9). It is an "umbrella" term which is used to include urban storm sewer drainage containing a variety of compounds from heavy metals to petroleum products, agricultural runoff, erosion and sedimentation, atmospheric deposition such as acid rain, chemical and fuel spills, and other pollutants coming from large land areas. Additionally, pollutants include "...nutrients such as

phosphorous and nitrogen, toxic substances, pathogens and organic materials such as sewage and food waste..." (Essman, 1989:25).

#### Background

Section 208 of the 1977 Clean Water Act requires states to develop nonpoint source pollution plans. By the end of 1984, only twenty states and the District of Columbia had developed erosion and sediment control laws directed at urban nonpoint source pollution (Harrington and others, 1985:27). This caused the EPA to issue the National Nonpoint-Source Policy on 12 December 1984. The objective was to support and accelerate the development and implementation of nonpoint source pollution management programs while recognizing the competing uses of funds (Holstine and Lowman, 1985:67). Since there were not any civil or criminal penalties associated with this policy, it could not mandate performance.

In 1987, the Water Quality Act attempted to correct this lack of implementation. This legislation requires the states to assess their surface waters, pinpointing those waters impacted by nonpoint source pollution, then developing and implementing management plans which address the problems. The EPA, in turn, will provide technical assistance. If any state(s) fail to follow through, the EPA is required to assess the problem. The management plans remain the states responsibility. Financing for these management plans is the state's responsibility, except where Congress has appropriated funds. The Water Quality Act recognizes that the states should have the flexibility to assess and develop management programs suited to their own unique situations. Most importantly, it recognizes that it will take time to

implement nonpoint source pollution control and it allows the states to set their own priorities (Hegewald, 1988:592-593).

Point source pollution has been regulated since the 1972 Water Pollution Control Act established the National Pollution Discharge Elimination System (NPDES). The EPA established strict industry effluent standards and issued permits. The burden for pollution abatement was placed on the polluter. This Act also authorized the EPA to levy fines on those polluters who violated their permits (Novotny, 1988:1406).

Nonpoint source pollution has not been handled as effectively as have point sources. It cannot be measured directly and violators cannot be located immediately. Mathematical models and professional judgement are used to determine the magnitude of the problem, rather than direct measurement. Loadings and pollutant discharges vary from month to month, and it is attenuated as it is transported (Novotny, 1988:1406).

To solve this dilemma, nonpoint source polluters are slowly being identified and regulated as point sources. The 1977 Surface Mining Control and Reclamation Act requires that runoff from mines meets the point source discharge requirements (Myers and others, 1985:14). A variety of federal, state and local programs help control erosion and sedimentation from agricultural operations through soil and water conservation districts (Essman, 1989:27-28). Large, concentrated feedlot operations can also be included in this list (Myers and others, 1985:15). Additionally, landfill leachate was added to the point source list by section 507 of the Water Quality Act (U.S. Congress, 1987).

Mitigating nonpoint source water pollution is rapidly becoming the nation's focal point for attaining the water quality goals set by the Water Quality Act of 1987. Nonpoint source pollutants create the same types of water quality problems as pollutants from point sources (Essman, 1989:25). Today, over 50% of the remaining pollution to our nation's waterways has been attributed to nonpoint source pollutants (Hegewald, 1988:590).

The cost of water pollution is staggering. From 1970 to 1984, \$100 to \$200 billion were spent to control it. About three-fourths of this outlay came from tax revenues and were used primarily for municipal sewage treatment construction (Wolman, 1988:1779). Abatement of one nonpoint source pollutant, sediment, accounts for approximately \$6 billion annually (Novotny, 1988:1404).

The priorities for cleaning up the environment must change. Strict controls on point source discharges will not significantly improve the water quality. Point source oriented programs alone cannot control nonpoint source pollution (Hegewald, 1988:590).

The Department of Defense and the U.S. Air Force have developed policies and best management practices to control nonpoint source pollutants in response to a Congressional mandate. The U.S. Air Force policy was outlined in a HQ AF/LEE letter dated May 1987 with implementation scheduled for January 1988 (Flora, 1987).

#### Problem Statement

Since no study could be found which had examined the implementation of nonpoint source pollution abatement at U.S. Air Force installations, this research focused on analyzing the current implementation level.

That is, are U.S. Air Force installations meeting federal, state and regional nonpoint source pollution regulatory standards?

Sources of Differences in Installation Implementation

There are several possible variables which affect the degree to which nonpoint source pollution abatement has been implemented at any given installation. One source of differentiation is the major command (MAJCOM) to which the installation belongs. A second source is the specific Air Force Regional Civil Engineer (AFRCE) district which provided guidance to the installation. A third source was the state in which the installation is located.

There are three AFRCE regions which have been examined for this study. Each AFRCE is responsible for the states which fall within their geographic region. These regions are known simply as the Eastern Region (ER), Central Region (CR) and Western Region (WR). The states for which each is responsible are listed below:

AFRCE-ER: Florida, Georgia, Mississippi, Alabama, North Carolina, South Carolina, Virginia, Maryland, Delaware, West Virginia, Kentucky, Tennessee, Pennsylvania, New York, New Jersey, Rhode Island, Connecticut, Vermont, Massachusetts, New Hampshire, Maine.

AFRCE-CR: Louisiana, Arkansas, Missouri, Iowa, Ohio, Indiana, Illinois, Michigan, Minnesota, Wisconsin, North Dakota, South Dakota, Montana, Wyoming, Utah, Colorado, Nebraska, Kansas, Oklahoma, Texas, New Mexico.

AFRCE-WR: Arizona, California, Nevada, Oregon, Washington, Idaho, Alaska, Hawaii. (AFRCE-CR, 1989:4-6)

Justification

In March 1990, Lee Thomas, a former EPA Administrator, predicted that the 1990s will see tighter water quality standards. Furthermore, he predicted that nonpoint source pollution will be acted upon, rather

than being just a matter for discussion (Curry and Bishop, 1990:10). Noncompliance with federal, state or local nonpoint source pollution standards will adversely affect the Air Force mission by curtailing operations, creating negative publicity and diverting limited funding from other areas. Immediate action is required to ensure that this does not happen.

#### Scope

Research into this topic included a review of the technical journals and literature concerned with identification and abatement of nonpoint source pollution. Air Force guidance and literature from HQ USAF/LEEV, Major Commands (MAJCOMs) and Air Force Regional Civil Engineers (AFRCEs) was reviewed to determine the strengths and the weaknesses of the abatement program when compared to federal, state and local regulatory requirements.

#### Investigative Questions

To determine the current implementation of nonpoint source abatement, the following investigative questions were derived:

1. Have major commands implemented nonpoint source pollution abatement measures at their installations? Is technical guidance on construction and natural resources management that would help curtail nonpoint source pollution being provided to the installations?
2. Are Air Force Regional Civil Engineers adequately providing coordination for the Air Force with state and federal regional agencies?
3. Have Air Force installations implemented nonpoint source pollution abatement procedures?
4. What can be done to improve implementation of nonpoint source pollution abatement?

### Organization of the Thesis

This thesis has been organized and presented in accordance with the format prescribed by AFIT's Style Guide for Thesis and Dissertations.

An introduction to this study is located in Chapter I. Chapter I contains the background, operational definition, problem statement, sources of differences, justification, scope, investigative questions and limitations by which this study was conducted.

Chapter II contains a review of the literature relevant to this study. The literature review focused on sources and possible control measures of nonpoint source pollution which are relevant to the U.S. Air Force. Additionally, a section discussing the applicability to the U.S. Air Force and the actual Air Force policy is included.

The methodology and design which were used while collecting and analyzing data are presented in Chapter III.

Chapter IV contains the findings and analysis of the collected data and answers the investigative questions leading to the study's specific objective.

Finally, the conclusions and recommendations for further research are detailed in Chapter V.

## II. Literature Review

### Overview

This chapter summarizes a review of the recent literature on nonpoint source water pollution. Emphasis was placed on identifying sources of nonpoint pollution, control measures, and the applicability to the U.S. Air Force.

### Sources of Nonpoint Pollution

Sources of nonpoint pollution vary from one geographic region to another. Agricultural sources are the most prevalent, followed by urban sources. Less significant sources include beach or shoreline erosion and atmospheric fallout. Locally significant sources may be leachate from waste disposal sites, failed septic systems, silvicultural operations, construction sites, and confined feedlots (Chesters and Schierow, 1985:10).

Agriculture. Agricultural production, including both crop and livestock production, accounts for about 63 percent of the nonfederal land usage in the United States. Nonpoint source pollution relates directly to the ways this land is used. Sediment, nutrients and pesticides are the primary pollutants from non-irrigated cropland. Irrigated cropland not only produces these pollutants, but they are also a source of salts and other minerals. The runoff from barnyards and confined feedlots carries organic matter, ammonia, fecal bacteria and other microorganisms, and nutrients to watercourses. Sediments and nutrients reside in runoff from overgrazed pastures and rangelands (Myers and others, 1985:15).

Urban. Storm water runoff transports many pollutants from urban areas. Sediments, debris from decaying pavements and buildings, heavy metals and inorganic chemicals, nutrients in fertilizers used in lawn care, fecal bacteria from animals (mainly pets and birds), and pesticides are all contained in this runoff. Significant impact on water quality can result (Myers and others, 1985:16).

One reason that this runoff is so harmful is the higher volume that results from the many impervious surfaces. Only about 10 percent of storm water runs off areas with natural ground cover. A direct correlation exists between the proportion of paved surfaces, and the volume and rate of runoff (and hence the pollutant level) increases. If 10 to 20 percent of the site's surface is paved, about 20 percent of the storm water becomes surface runoff (Myers and others, 1985:16).

Mining. Although mining is not as widespread as agricultural operations, the impact on water quality can be much higher. Large areas are often exposed, leading to high rates of erosion. Spoil piles and old tailings may include heavy metals and radioactive materials. Acid drainage of surface and underground coal mines inhibit fish spawning and destroy the organisms which fish and other aquatic species depend upon (Myers and others, 1985:15-16).

Construction. Sediment is the main pollutant from construction sites, but it accounts for only four to five percent of the sediment reaching watercourses. However, the localized impacts may be extremely severe. Soil erosion rates are typically 10 to 20 times higher than those from agricultural lands, and these erosion rates have been observed to be as high as 100 times that of agricultural lands. Thus,

construction sites can contribute more sediment to streams than was deposited over several decades (Myers and other, 1985:17).

Construction sites also produce other pollutants such as fertilizers, pesticides, petroleum products and a variety of construction materials. These pollutants are deposited on an estimated 1.6 million acres of land annually, and they are toxic to aquatic organisms, degrade drinking water supplies, and reduce water-contact recreation (Myers and others, 1985:17).

Silviculture. Silviculture operations generate nonpoint source pollution in many ways. Road construction, pesticide application, harvesting and logging operations, and site preparation for replanting are some examples. Well managed logging operations experience erosion rates of 20 to 30 times that of mature forests. Intensive site preparation for revegetation can yield erosion rates of 200 times that of mature forests. Pesticide and fertilizer applications normally occur once or twice during a 20- to 35-year period, yet they are usually conducted by aerial applications near watercourses. Severe localized problems may result from any of these (Myers and others, 1985:18).

#### Federal Nonpoint Source Legislation

Until recently, the U.S. Congress has focused on attaining the applicable water quality standards by regulating point sources. Sedimentation in navigable waters and erosion from agricultural lands were only regulated in order to protect commercial activities, not because they were pollution sources. This began to slowly change with the passage of the Clean Water Act of 1977. It was here, for the first time, that the Congress recognized that nonpoint source pollution could

adversely affect the quality of the nation's waters. Section 208 of this Act specifically addressed the need to control nonpoint source pollution from agricultural lands (P.L. 95-217).

In 1987, the Congress passed the Water Quality Act. This legislation has set forth the guidelines for controlling nonpoint source pollution. First, the "Congressional declaration of goals and policy" (33 USC 1251) from the Clean Water Act was amended with the addition of a seventh provision. This provision states that

It is the national policy that programs for the control of nonpoint sources of pollution be developed and implemented in an expeditious manner so as to enable the goals of this Act to be met through the control of both point and nonpoint sources of pollution (33 USC 1251).

The Water Quality Act also amended or added several U.S. Codes. These Codes mandate specific action by the states. In accordance with 33 USC 1314, each state must submit to the EPA, by 4 February 1989, a control strategy for toxic pollutants in navigable waters to include both point and nonpoint sources of pollution. The purpose of each control strategy is to achieve the applicable water quality standard not later than three years after the date of strategy's establishment (33 USC 1314). In 33 USC 1315, Congress stipulated that each state must, on a biennial basis, prepare and submit a report to the EPA that includes a description of the nature and extent of nonpoint sources of pollutants, and recommendations as to the programs which must be undertaken to control each category of such sources, including an estimate of the costs of implementing such programs. (33 USC 1315)

This report shall also include

an assessment of the status and trends of water quality in lakes...including, but not limited to, the nature and extent of pollution loading from point and nonpoint sources...." (33 USC 1324)

The most significant Code that was enacted by the Water Quality Act is 33 USC 1329, "Nonpoint source management programs". It first consolidates the requirements set forth by the Codes discussed previously. More importantly, it details the requirements for the state management programs. Specifically, each program will include provisions for each of the following:

- 1) Identification of the best management practices that will be used to reduce pollutant loadings resulting from nonpoint sources.
- 2) Identification of the programs which will be used to achieve the implementation of the best management practices.
- 3) A schedule containing the annual milestones for using the programs and best management practices listed above.
- 4) Certification that the laws enacted provide adequate authority to implement those programs listed above. If additional authority is required, a listing of those authorities, and a schedule and commitment to seek such additional authorities as soon as is practical.
- 5) Sources of Federal and other assistance and funding required to implement these programs.

Additionally, this management program will, to the maximum extent practical, be used on a watershed-by-watershed basis within each state. Congress has tasked the EPA to prepare a report, for any state which has not complied, which makes the identification required above "within 30 months after February 4, 1987".

Finally, the EPA has been given the authority to make grants to any state which has implemented or is proposing to implement management programs which will

- (1) Control particularly difficult or serious nonpoint source pollution problems;
- (2) Implement innovative methods or practices for controlling nonpoint sources of pollution;
- (3) Control interstate nonpoint source pollution problems; or

(4) Carry out groundwater quality protection activities which are part of a comprehensive nonpoint source pollution control program to include research, planning, ground water assessments, demonstration programs, enforcement, technical assistance, education, and training to protect ground water quality from nonpoint sources of pollution.

Total grants authorized by this Act totaled \$400 million for fiscal years 1988 through 1991 (33 USC 1329).

#### Nonpoint Source Pollution Control

Controlling nonpoint source pollutants is a complicated issue. A decision must be made to determine who is responsible for abatement and cleanup actions. Additionally, alternate ways of controlling the emission of nonpoint source pollutants into surface waters needs to be explored. Finally, methods must be found which will correctly identify the areas which are producing nonpoint source pollutants.

Equity Considerations. Abatement of nonpoint source pollution will be as costly as point source pollution (Essman, 1989: 25). This cost can be distributed in three ways. First, the entire cost can be placed directly on the polluter. Second, the beneficiaries of improved water quality can either provide subsidies and grants to the polluters to reduce or eliminate pollutant loads, or the beneficiaries can cleanup the environment themselves (Novotny, 1988:1409). Finally, a combination of the two approaches can be used.

The polluter-pays approach. The NPDES permit system is an example of the polluter-pays approach. The original Congressional intent was to apply NPDES to only point sources. The EPA expanded it to include pollution sources which had been previously defined as nonpoint sources. Examples of this include combined sewer overflows, runoff from

confined animal feedlots, and, most recently, effluent from storm sewers (Novotny, 1988:1409).

Novotny advocates that this principle is the most equitable, for land owners and manufacturers do not have the right to pollute, even if they produce food or manufacture goods which are essential and beneficial to society. Costs to abate nonpoint source pollution from construction should be passed to the user, whether it is residential home owners or manufacturing firms. Urban dwellers should be taxed to pay the cost of nonpoint source abatement from urban runoff (Novotny, 1988:1409-1410).

Harrington asserts that voluntary compliance with this approach will not work. Costs are cut wherever possible to sell a product ahead of the competition. Government regulation keeps agricultural prices artificially low and subsidies often hinder farmers from implementing practices to control nonpoint source pollution (Harrington and others, 1985:31). Moral suasion, education and technical assistance must be used to convince polluters that the on-site benefit of pollution abatement can be used to offset the cost (Harrington and others, 1985:28; Novotny, 1988:1410).

The cradle-to-grave philosophy that the Congress has allowed the EPA to enforce is an example of this. The cradle-to-grave concept dictates that generators of hazardous wastes are responsible for this waste from the moment it leaves their site until it is disposed of and poses no harm to the environment. If, in the future, this waste poses a hazard to the environment, the generator is still responsible for any necessary clean-up actions. This could easily be the way that nonpoint

source pollutants are handled.

The benefits-received approach. The benefits-received approach works within the existing concept of property rights. Farmers and other land owners retain the rights to use the land as they see fit. Anyone who expects to benefit from a change in the land owner's behavior must pay for that change (Liddy, 1985:34). A grant or a subsidy can be used to pay a polluter not to pollute when the cost of abatement is less costly than the cost of cleanup. This system has seen widespread use in the United States to control soil erosion and other agricultural pollutants (Novotny, 1988:1410).

The integrated approach. In many cases, an integrated approach may be the best solution. Partial subsidies to farmers is one example of this. A subsidy is used to partially offset the cost of changing a farmer's practices, allowing this change to become economically feasible for the farmer and reducing the amount of pollution emitted. Food costs remain low because the farmer does not have to pay the entire cost of abatement. Both parties are satisfied.

Best Management Practices. One of the many possible solutions for nonpoint source pollution control is the implementation of best management practices (BMPs). All types of nonpoint source pollution can be mitigated by implementing BMPs. In many cases, this may be the best, most economical solution to the nonpoint source pollution problem (Flora, 1987:Atch 1).

The greatest potential for utilizing the full range of BMPs is in urban areas which are under development. Proper land use planning can reduce runoff volume and corresponding runoff loads significantly.

Effective soil erosion control can be easily established for construction sites (Myers and others, 1985:16-17).

Retention and detention basins can capture over 80 percent of the sediments carried by storm water. The cost of one such structure can be as low as \$300. Mulches and other ground covers can effectively reduce erosion by as much as 95 percent. Mulches typically cost between \$200 to \$1500 per acre (Flora, 1987:Atch 2).

BMPs can also reduce nonpoint source pollution from the application of pesticides and fertilizers. Less of these products can be applied at optimum intervals and under the proper conditions to reduce the contamination to runoff (Essman, 1989:26).

Innovative Identification. Identification of nonpoint source pollutants is often based on the absence of uncontrolled point sources (Essman, 1989:25). Better ways must be used if nonpoint source pollution is to be controlled. The Tennessee Valley Authority (TVA) has one such method.

In 1984, the TVA began using infrared color aerial photographs to map nonpoint source pollutants. At first, the emphasis was on the identification of malfunctioning septic tanks. Later, it was expanded to include agricultural nonpoint sources, groundwater impacts and urban areas. This has allowed the TVA to inventory 11,900 square miles at costs between \$40 and \$150 per square mile (Perchalski and Higgins, 1988:62). Other state or regional agencies could inexpensively use this approach to identify the origin of nonpoint source pollutants.

### Air Force Applicability

In 1984, the EPA identified nonpoint source pollution as a significant national environmental concern (Flora, 1987:Atch 1). Three years later, the U.S. Congress passed the Water Quality Act which, for the first time, specifically addressed urban nonpoint source pollution (Humenik and others, 1987:738). Subsequently, the states were delegated the authority to develop standards and to establish best management practices for controlling the nonpoint source pollution (Flora, 1987:Atch 1).

As with other significant environmental legislation, military installations must comply with federal and state statutory standards, for they have many activities which yield nonpoint source pollutants. As yet, a state environmental regulatory agency has not imposed a fine on a military installation or commander, though current views at HQ AF/LEE indicate that it is only a matter of time before this happens (Seminar Presentation in EMGT 556, 1989). The Department of Defense (DoD) issued instructions to the military services to establish a nonpoint source pollution control program. The current DoD strategy contains several key points. It includes technical information exchanges, increased awareness to nonpoint source pollution in planning and construction, training and education on nonpoint source pollution abatement, coordination with local water quality planning authorities and compliance reviews at all management levels (Flora, 1987:Atch 1).

This strategy will be implemented at all management levels within the military services. The strategy states that all management levels will:

- (1) Include nonpoint source pollution management in planning, policy, operations and maintenance, and construction.
- (2) Support, and coordinate with, other federal, state, area-wide, local, and private sector nonpoint source pollution management agencies in assessing and controlling nonpoint source pollution.
- (3) Monitor and report the status of nonpoint source pollution control actions. (Flora, 1987:Atch 1)

Air Force Policy. The Air Force nonpoint source policy was defined in a letter from Gary S. Flora dated 5 May 1987. Mr. Flora is the Associate Director, Directorate of Engineering and Services, Headquarters, U.S. Air Force. This letter mandated that identification of nonpoint source pollution problems be accomplished by 1 September 1987 and that nonpoint source pollution control programs be implemented by 1 January 1988. To meet this goal, the responsibilities of various management levels within the Air Force were given. In the following discussion on these management levels, the reader is assumed to be familiar with both Air Force office symbols and Air Force Civil Engineering hierarchy.

HQ USAF/LEEV. The Headquarters Air Force Environmental Engineering Division is to provide the policy and management for nonpoint source pollution control. They will coordinate nonpoint source pollution control activities with DoD components and other federal agencies. Status reports on the implementation of these programs will be provided to the DoD.

AFRCEs. Air Force Regional Civil Engineers will perform the overall nonpoint pollution control coordination with state, federal and regional agencies. The AFRCEs will assist installations on all nonpoint

source matters by maintaining a current file of state and regional nonpoint source pollution standards and regulations.

MAJCOMs. Major Commands will identify nonpoint source pollution problems on their installations and implement nonpoint source pollution control programs to correct those problems. Technical guidance on construction and natural resources management will be provided to installations for the control of nonpoint source pollution.

Installations. The policy letter lists 10 points for each installation to consider. They are:

(1) Contact the AFRCE to receive up-to-date state nonpoint source pollution control requirements.

(2) Obtain the assistance of the local Soil Conservation Service, state Agricultural Extension Service, or state water quality agency offices in reviewing base land management practices, identifying nonpoint source pollution problems, and determine the best management practices for reducing base nonpoint source pollution.

(3) Include stipulations in construction, fish and wildlife management, grazing, and forest harvest contracts and projects to reduce erosion during ground disturbance, and include measures to rehabilitate areas after disturbance.

(4) Include best management practices for controlling nonpoint source pollution in land management, grazing and cropland, fish and wildlife, outdoor recreation, and forestry plans.

(5) Include best management practices in land use regulations for grazing and cropland lease requests.

(6) Inspect logging, access, perimeter, and off-road vehicle roads and trails for erosion, and maintain these roads and trails so as to prevent erosion.

(7) Implement erosion control measures in military training and recreation areas.

(8) Ensure that no excess fertilizer is applied to improved grounds, golf courses, and cropland.

(9) Obtain necessary permits from state water quality control agencies.

(10) Provide for nonpoint source pollution control in installation planning and decision-making. (Flora, 1987:Atch 2)

Summary

Nonpoint source pollution is a significant problem which must be addressed at all levels within our society. Emphasis on cleaning up point source discharges will not significantly improve the quality of our water (Hegewald, 1988:590). Nonpoint sources must be isolated and controlled.

The Tennessee Valley Authority has developed an inexpensive and innovative method of using infrared aerial photograph to significantly combat nonpoint source pollution on over 11,900 square miles (Perchalski and Higgins, 1988:62). Best management practices can then be used to abate these problems. Many of these practices are inexpensive and easy to implement, especially when compared to the cost of cleanup.

### III. Methodology

#### Overview

This chapter describes the steps which were taken to answer the three investigative questions posed in Chapter I. These investigative questions examined the implementation of the U.S. Air Force nonpoint source pollution abatement policy. They were:

1. Have major commands implemented nonpoint source pollution abatement measures at their installations? Is technical guidance on construction and natural resources management that would help curtail nonpoint source pollution being provided to the installations?
2. Are Air Force Regional Civil Engineers adequately providing coordination for the Air Force with state and regional agencies?
3. Have Air Force installations implemented nonpoint source pollution abatement procedures?
4. What can be done to improve implementation of nonpoint source pollution abatement?

#### Data Collection Procedures

The primary research which was conducted precluded using any formal data collection procedures. Since it was not feasible to survey every installation, the initial attempts were focused at identifying the questions to pose to the MAJCOMs and AFRCEs to attain the data necessary to answer the research questions listed above.

Informal telephone calls were placed to several individuals who work in various environmental engineering capacities at the installation, MAJCOM and AFRCE levels. Information obtained from a MAJCOM source directed inquiries to HQ USAF/LEEVN, who in turn identified HQ USAF/LEEVN as the office of primary responsibility (OPR) for Air Force nonpoint source pollution abatement. It was this latter

office which provided much of the insight into the proper questions to ask to obtain the desired research data.

The status (as of January 1990) of Clean Water Act compliance at twenty major waste water discharging installations was provided by HQ USAF/LEEVC. This produced a population of installations at which NPDES violations had occurred, and at which the MAJCOM had determined there was a significant potential for environmental damage or noncompliance to state or local statutory regulation(s). Oil/water separators account for the majority of the violations which can be linked to nonpoint sources of pollution. A copy of the information request has been included in Appendix A on page 68.

Status reports nonpoint source pollution control were compiled by the MAJCOMs in April 1989 and attained from HQ USAF/LEEVN. These reports provided a baseline population of installations which had implemented nonpoint source pollution abatement procedures. Since the status reports did not list every installation, generalizations about the missing installations cannot be made using this data.

Data was collected on federal, state and local regulations using a two-tiered approach. The AFRCEs were contacted to obtain data on states which had been identified as having laws governing nonpoint source pollution. The Environmental Technical Information System (ETIS) was used to access the Computer-aided Environmental Legislative Data System (CELDS). ETIS was developed jointly by the Army Corps of Engineers and the University of Illinois and is currently maintained by the latter at the University of Illinois at Urbana-Champaign. CELDS is a database of abstracted federal and state environmental regulations designed to

provide quick access to environmental rules. The abstracts are intended to be used as a guide and are not a substitute for proper legal advice or for the original regulation. In addition to the abstracts, CELDS provided points of contact at state regulatory agencies. In short, CELDS provided a means for verification of information received from both HQ USAF/LEEV and AFRCEs.

The external validity of this study was of the utmost importance. External validity has been described as the ability to generalize across times, settings, or persons (Emory, 1985:118). A census of every installation would have provided for the highest degree of generalization. However, the exploratory nature of this study and the time limitation placed upon it did not allow this. Therefore, installations, which were referenced in more than one data source, were used to maximize the degree of generalization possible.

The letters that were sent to the MAJCOMs and AFRCEs requested a copy of, or applicable excerpts from Natural Resource Protection Plans such as the Land Management Plan, Grazing and Cropland Plan, and Forestry Management Plan. Additionally, any information concerning state laws relevant to the subject matter, Best Management Plans (BMPs) or other abatement actions which are currently implemented, and relevant excerpts from any report such as the Environmental Compliance Assessment and Management Program (ECAMP) was requested. To obtain maximum participation, the purpose of the request, an expression of appreciation for participation, and the guarantee of anonymity were also included in the letter. Finally, the MAJCOM and AFRCE letters asked for the name and telephone number of a point of contact for which questions could be

directed. A copy of the letter has been included in Appendix B on page 69.

Conducted by installations every year and by the MAJCOM once every three years, the ECAMP process provides a systematic and objective assessment in not intended to produce an environmental evaluation.

Instead,

the primary objective of ECAMP is to establish a self evaluation program for enhancing, maintaining, and monitoring Air Force compliance with environmental laws and regulations through the use of environmental compliance evaluations. (Kane, 1988)

The nonpoint source pollution excerpts from these ECAMP reports were of special interest, since they should contain specific information relevant to the subject of this research.

Responses to these informational requests were expected from at least 80 percent of the MAJCOMs and AFRCEs. The conclusions listed in Chapter V can be generalized for only the installations contained in the data, their MAJCOM and AFRCE region. The recommendations and best management practices presented in Chapter V present guidance which environmental coordinators can use to abate nonpoint source pollution.

#### Data Analysis Procedures

A database was created from the collected information. Five categories were formed to consolidate the information by the source of the nonpoint source pollutant abatement. The categories were agricultural, urban, construction, silviculture and other. Responses were treated as Bernoulli random variables. That is, the installation was determined either to have the given characteristic or to not have it (Devore, 1982:82). The use of Bernoulli random variables then allowed

the researcher to obtain a percentage of the applicable nonpoint source abatement categories that were currently implemented in each of the MAJCOMs. These percentages cannot be used for direct comparisons between any of the MAJCOMs. Additionally, MAJCOM, AFRCE region and resident state was recorded for each installation.

Several activities were placed in the agricultural category. They include, but are not limited to, livestock grazing, herbicide spraying, erosion, agricultural fertilizer application, and irrigation. The urban category was used to classify pesticide spraying, street sweeping for sediment control, and fertilizer application (non-agricultural). Controlling erosion and debris removal from construction sites were placed in the construction category. The silviculture category included any of the above which were applicable to commercial forestry operations on an installation. Finally, the other category was used to classify petroleum spills and any other information that would not fit into the previous categories.

The first two research questions were answered using the primary data that was obtained from the Natural Resource Protection Plans, the ECAMP excerpts, information on state laws and policies, other miscellaneous information contained in the MAJCOM and AFRCE responses to the informational requests, and the data obtained from CELDS. The collected data was qualitatively analyzed by installation under the appropriate MAJCOM, AFRCE, and state approach. This made identification of external factors affecting the implementation of nonpoint source pollution abatement procedures possible. These external factors were used to answer the first two research questions.

The third research question was answered using primary data from the ECAMP excerpts, consolidated MAJCOM listings of nonpoint source pollution programs and projects, and MAJCOM status reports on nonpoint source pollution that were compiled by the HQ USAF/LEEVN. This qualitative analysis could not be generalized to all Air Force installations, since the absence of information on any given installation could not be attributed to a lack of implementation.

The fourth research questions was answered using the responses to the information request, the Air Force Policy Letter, and information found during the literature review.

#### Summary

The final step in this study was to generalize the findings and to provide recommendations for installation environmental coordinators. The findings in Chapter V were presented to the School of Civil Engineering and Services at AFIT for review and validation. The exploratory database that was collected and the recommendations for installation environmental coordinators have been provided the School of Civil Engineering and Services for use in refining nonpoint source pollution abatement lectures for their environmental protection classes.

#### IV. Results and Analysis

##### Overview

The purpose of this study was to examine the implementation of nonpoint source pollution abatement at U.S. Air Force installations by determining the degree of compliance with federal, state and regional regulatory requirements. The analysis of data is presented in this chapter.

This chapter is divided into six parts. First, the chapter begins with a discussion of who responded to the Major Command (MAJCOM) and Air Force Regional Civil Engineer (AFRCE) information request. Then, each of the four investigative questions is answered. The chapter then ends with a brief summary.

##### Distribution of Respondents

Eleven of fourteen (or 78 percent) organizations responded to the request for information. The MAJCOM and AFRCE distribution list is included in Appendix C on page 71. A list of all respondents to informational requests is located in Appendix D on page 72. These responses yielded data on 83 percent (ten of twelve) of the MAJCOM nonpoint source pollution abatement programs. Seventy-two installations in 37 states were included in the data.

The data on the installations was grouped by MAJCOM, AFRCE and state. Information received from HQ USAF/LEEVC and HQ USAF/LEEVN included installations not covered by the MAJCOM responses or from MAJCOMs which did not respond. Only two of the three AFRCE regions responded to the request for information.

Summaries of the various groupings are shown below. Table 1 summarizes the installations represented in the data by MAJCOM. A similar summary by AFRCCE region is presented in Table 2. Table 2 also shows the number of installations located in a given state.

Table 1  
Installations Represented in the Data  
by MAJCOM

MAJCOM	Number of Installations	Relative Percentage of Installations Within the Data
AFLC	7	10
AFRES	3	4
AFSC	3	4
ATC	4	6
AU	2	3
MAC	9	13
PACAF*	3	4
SAC	21	29
SPACECOM	3	4
TAC	17	24

\* Hawaiian installations only.

Table 2

Installations Represented in the Data  
by AFRCE and State

AFRCE Region	State	Number of Installations	Percentage of Total *
Eastern	Alabama	1	1.4
	Delaware	1	1.4
	Florida	4	5.6
	Georgia	4	5.6
	Mississippi	1	1.4
	Maine	1	1.4
	Maryland	1	1.4
	New Hampshire	1	1.4
	New Jersey	1	1.4
	New York	2	2.8
	North Carolina	2	2.8
	Pennsylvania	1	1.4
	South Carolina	3	4.2
	Virginia	1	1.4
TOTAL		24	33.3
Central	Arkansas	2	2.8
	Colorado	3	4.2
	Illinois	1	1.4
	Indiana	1	1.4
	Kansas	1	1.4
	Louisiana	2	2.8
	Michigan	1	1.4
	Missouri	1	1.4
	Montana	1	1.4
	Nebraska	1	1.4
	New Mexico	2	2.8
	North Dakota	2	2.8
	Ohio	3	4.2
	Oklahoma	3	4.2
	South Dakota	1	1.4
	Texas	6	8.3
	Utah	1	1.4
TOTAL		32	44.4
Western	Arizona	3	4.2
	California	7	9.7
	Hawaii	3	4.2
	Idaho	1	1.4
	Nevada	1	1.4
	Washington	1	1.4
TOTAL		16	22.2

\* Percentages are not additive due to rounding.

### MAJCOM Implementation

The purpose of the first investigative question was to determine if the MAJCOMs had implemented nonpoint source pollution abatement measures at their installations. The data was also analyzed to determine if technical guidance on construction and natural resources management which would help curtail nonpoint source pollution had been provided by the MAJCOM to the installations. This requirement is set forth by the Air Force policy which is discussed in Chapter 2, beginning on page 18.

A database was created from the collected information. Five categories were formed to consolidate the information by the source of the nonpoint source pollutant abatement. The categories were agricultural, urban, construction, silviculture and other. Responses were treated as Bernoulli random variables. That is, the installation was determined either to have the given characteristic or to not have it if they exhibited any abatement activity within an abatement category (Devore, 1982:82). Additionally, MAJCOM, AFRCE region and resident state was recorded for each installation.

The urban category was used to classify management practices for controlling nonpoint source pollution from pesticide spraying, street sweeping for sediment control, and fertilizer application (non-agricultural). Several management activities were placed in the agricultural category. They include, but are not limited to, those practices aimed at reducing the nonpoint source pollution impact from livestock grazing, herbicide spraying, erosion control, agricultural fertilizer application, and irrigation. Controlling erosion and debris removal from construction sites were placed in the construction

category. The silviculture category included any of the above which were applicable to commercial forestry operations on an installation. Finally, the other category was used to classify such management practices as the clean up of petroleum spills and any other information that would not fit into the previous categories.

Table 1 (on page 28) was expanded for each of the MAJCOMs to include installation name and applicable categories of nonpoint source pollutant abatement. If the category was not applicable to an installation or if the data was incomplete, then that specific entry was not included in further analysis. This supplemental table has not been provided in order to protect the anonymity of the MAJCOMs and the installations.

The amount of nonpoint source abatement for each MAJCOM was then determined. Since, the format and content of each of the responses varied greatly, any reference to an abatement practice within a category led to the installation receiving credit for nonpoint source pollution abatement in that specific category. MAJCOM implementation levels were then computed by using the ratio of total implemented categories at every installation which was contained in the data to total applicable categories for all installations.

The percentages are intended to provide an indication of the number of applicable categories of nonpoint source pollution abatement that the installations within a MAJCOM have implemented. The percentages shown in Table 3 on the next page cannot be used to directly compare the abatement programs between MAJCOMs. Intra-command generalizations were only made for those MAJCOMs which had at least half of their

installations represented in the data. Consequently, generalizations were not made for three of the MAJCOMs. Significant data was present for these MAJCOMs and is included in the discussion of each MAJCOM. A random numeric value has been assigned to each MAJCOM to protect their anonymity.

Table 3  
MAJCOM Implementation Levels

MAJCOM Designation	Overall Implementation Level (Percentage)
1	61
2	63
3	75
4	75
5	47
6	55
7	100
8*	33
9*	100
10*	0

\* Indicates a MAJCOM for which the number of installations represented in the data is too small for any generalizations to be made.

MAJCOM #1. The installations in MAJCOM #1 have implemented nonpoint source abatement procedures in many different ways. One of the MAJCOM's stated goals is to coordinate all of the installation natural

resource plans with the Soil Conservation Service. As of May 1989, MAJCOM #1 reports that 65 percent of its installations are complying with this goal, and expects to have 90 percent of its applicable installations achieve this coordination.

The range for overall implementation (as determined by the researcher) was from 25 to 80 percent. Table 4 summarizes the implementation level for each of the five nonpoint source pollution abatement categories described earlier. These percentages are intended to provide an indication of the number of applicable categories of nonpoint source pollution abatement that the installations within MAJCOM #1 have implemented. The percentages shown in Table 4 cannot be used to directly compare the abatement programs between MAJCOMs.

Table 4  
MAJCOM #1 Summary

Category	Implementation Level	MAJCOM Asserted Implementation Level
Agriculture	69	77
Urban	6	NA
Construction	100	95
Silvaculture	80	100
Other	68	NA

Included in Table 4 is the implementation level that MAJCOM #1 has asserted it has attained. The MAJCOM did not specify how they derived their implementation levels. These percentages are included to provide

same validation of the researcher's methodology in determining implementation levels for this and the other MAJCOMs. These differences between the researcher's implementation level and those asserted by MAJCOM #1 are not significant.

Agricultural nonpoint source pollution abatement measures being used within MAJCOM #1 vary significantly between installations. Only one installation was observed having a comprehensive abatement strategy. This strategy is included in agricultural leases, and it addressed cropping sequence, contour farming, conservation tillage, crop residue, field border, grassed waterways, and terracing. Grassed waterways were also used at most of the other installations in which agricultural abatement measures were applicable. There was one installation which reported that it excluded livestock from about 200 acres of land adjacent to lakes, rivers and wetlands. At another installation, it is noted that this exclusion has not been done since there has not been any observed erosion in these areas.

Construction nonpoint source abatement measures appear to be standardized across MAJCOM #1. Generally, every installation requires contractors to lay mulch on bare ground, minimize the amount of bare ground exposed at any one time, and revegetate areas after construction. Most of the installations also noted that sediment basins and/or straw bales/siltation fences are used to remove sediment from storm water.

Silviculture nonpoint source abatement measures also appear to be standardized. With one exception, every applicable installation selectively harvests its forests. Clear cutting is only used selectively. Most of the installations also plan roadbeds to limit

erosion and leave buffer strips along stream banks. One installation noted that directional falling is used on steep slopes to minimize erosion. One installation noted that "nonpoint source pollution abatement relating to forestry is generally not used." This installation was not given credit for any abatement measures in this area. However, the installation may have incorrectly interpreted the preceding statement to equate "forestry" with the commercial harvesting of timber (or silviculture). This would resolve the difference between the MAJCOM reported implementation level and that determined by the researcher.

The most prevalent "other" nonpoint source abatement measure that is used concerns the coordination of natural resource plans with the applicable soil conservation district. One installation has even created a separate section on nonpoint source pollution abatement in these plans.

Of the installations in MAJCOM #1 that have been identified by HQ USAF/LEEVC as violating the Clean Water Act (CWA), the noncompliance at two installations can be partially attributed to nonpoint source pollution. At the first installation, major portions of the flight line have extensive storm water drainage systems which are not treated prior to discharge from the base. Consequently, the installation has been cited for discharging hazardous wastes. The other installation is violating its National Pollutant Discharge Elimination System (NPDES) permit for surfactants. The surfactants enter the storm water system from runoff from aircraft maintenance areas. The occasional foaming has been attributed to deicing fluids and urea.

The data suggests that MAJCOM #1 has implemented nonpoint source abatement procedures in all areas except urban nonpoint source pollution abatement. The one exception to this was the documented use of street sweeping to minimize particulates in storm water. Undoubtedly, other installations are sweeping their streets, but are unaware that it is a method of reducing urban nonpoint source pollution.

MAJCOM #2. MAJCOM #2 has installation implementation levels which range from 0 to 100 percent. Table 5 below summarizes the implementation level for each of the five nonpoint source pollution abatement categories described earlier. MAJCOM #2 does not have any installations at which silvaculture operations occur.

Table 5  
MAJCOM #2 Summary

Category	Implementation Level
Agriculture	83
Urban	13
Construction	88
Silvaculture	NA
Other	75

The wide degree of implementation appears to be directly related to state and regional nonpoint source pollution requirements. As with MAJCOM #1, the data suggests that MAJCOM #2 has implemented nonpoint source abatement procedures in all areas except urban nonpoint source

pollution abatement. The one exception to this was the documented use of street sweeping to minimize particulates in storm water.

One installation that had implemented abatement measures in all applicable areas except the urban category falls within the jurisdiction of a regional commission formed to protect a single watershed. This was the most comprehensive program observed at any of the installations.

Extensive coordination was evident between the installation and the local soil conservation district, the Sediment and Stormwater Division of the state Department of the Environment, the National Parks and Planning Commission for the watershed, and the DoD study group for the watershed.

This installation has actively pursued nonpoint source pollution abatement since September 1986. At this time, the Land Management Plan was amended using recommendations from the previously mentioned groups. These amendments included all construction projects requiring more than 2,000 square feet of land to be disturbed to submit a stormwater management plan in accordance with the "Stormwater Management Guidelines for State and Federal Projects". The minimum abatement measures that will be used to control construction nonpoint source pollution includes the use of perimeter dikes, silt fences, sediment traps, temporary or permanent seedlings, or other controls depending on the site. The amendment also included provisions for a feasibility study designed to determine the adequacy and possible need for additional stormwater/oil separators around the motor pool and the POL bulk storage yard. The last section of this amendment was directed towards the direct stream protection. All areas within 50 feet of stream banks will be cleared of

rubbish semiannually, and it will not be mowed to allow for reforestation. Stream banks not already protected by concrete will be protected by measures such as riprap and gabion baskets.

This is the only installation which was observed to use the base newspaper as a means of educating the base populace in nonpoint source pollution protection. At least once a year, an article is published focusing on the watershed protection program.

On the other side of the nonpoint source pollution abatement spectrum was an installation which has not implemented any abatement procedures. This installation cited the "nonexistence of heavy construction activity" as justification for not implementing any nonpoint source abatement procedures.

Another installation in MAJCOM #2 is located adjacent to an Army installation and the Air Force Base acreage is included in the Army installation's Natural Resources Protection Plan. No nonpoint source pollution abatement information is contained in this plan, and due to manpower constraints, efforts are not being directed to remedy this. In the absence of a formal plan, the installation has still implemented some nonpoint source pollution abatement procedures. These procedures include the following:

- 1) Coordination with the Army installation and the surrounding communities to ensure the joint land use program is compatible with protecting the environment.
- 2) Including stipulations in construction contracts designed to reduce nonpoint source pollutants.
- 3) Proper application of fertilizer, herbicides, insecticides and pesticides by qualified personnel only when there is not any possibility of excess runoff of hazardous substances due to heavy rain.

This installation asserts that it is in compliance with state and federal environmental standards.

Nonpoint source abatement is somewhat standardized at the remaining installations. Much emphasis appears to be placed on mitigating those nonpoint source pollutants which result from construction. Common practices include using straw bales in roadside swales to reduce erosion, requiring that contractors use good "housekeeping" practices, utilizing site planning which accounts for the existing topography, and using mulches and other ground covers on exposed soils. Other nonpoint source abatement measures include using oil/water separators to treat runoff from industrial areas and, using riprap along stream banks to prevent erosion.

MAJCOM #3. The installations in MAJCOM #3 are maintained by one, centralized unit. It follows that the nonpoint source abatement practices at the installations would be the same. However, the summary located in Table 6, on the next page, reflects the data obtained from HQ USAF/LEEVN.

As with MAJCOMs #1 and #2, the data suggests that MAJCOM #3 has implemented nonpoint source abatement procedures in all areas except urban nonpoint source pollution abatement. The state has inspected the installations and has recommended changes to reduce nonpoint source pollution. These recommendations included many best management practices which are reported as being implemented. Eroded hillsides and abandoned access roads and road shoulders will be repaired and maintained to prevent further erosion damage. Once repaired, the mowing of weeds in these areas will be accomplished by smaller riding mowers

instead of the heavy equipment which was being used. Pesticide, herbicide and fertilizer use will be strictly monitored to prevent misuse. Since these recommendations did not address urban nonpoint source pollution, current practices must be acceptable or the state does not consider the abatement of urban nonpoint source pollutants important.

Table 6  
MAJCOM #3 Summary

Category	Implementation Level
Agriculture	67
Urban	0
Construction	33
Silvaculture	NA
Other	33

The nonpoint source pollution control program that has been established for the installations in MAJCOM #3 has been extensively coordinated and technical assistance provided from many federal and state agencies. These federal agencies include the U.S. Soil Conservation Service, the U.S. Army, the U.S. Department of the Interior, the U.S. Department of Agriculture, and the U.S. Environmental Protection Agency. State agencies included the Soil Conservation Service, the Department of Health, the Department of Agriculture, the Department of Land and Natural Resources, and Agricultural Research and Extension Service from the state university.

MAJCOM #4. Like MAJCOM #3, the installations in MAJCOM #4 are located within the confines of a single state. The range for overall implementation of nonpoint source pollutant abatement levels is from 50 to 100 percent. Table 7, located below, summarizes the implementation level for each of the five nonpoint source pollution abatement categories.

Table 7  
MAJCOM #4 Summary

Category	Implementation Level
Agriculture	100
Urban	50
Construction	50
Silvaculture	NA
Other	100

The data suggests that MAJCOM #4 has implemented nonpoint source abatement procedures in all areas. This is significant in light of the fact that the State has yet to implement any nonpoint source pollution regulations. Implementation of these regulations is expected to be in September 1990. This lack of state regulatory requirements was verified by the Computer-Aided Environmental Legislative Data System (CELDS). A discussion describing the information obtained from CELDS is located in Appendix F, beginning on page 75 of this text.

A natural resources plan for one of the installations was provided for analysis. Nonpoint source pollution abatement measures were only

evident for controlling erosion and the proper use of pesticides. The erosion control measures were the most detailed of any observed installation. The plan specifies that improved grounds will be repaired within two days of identification, while semi-improved grounds will be repaired within five days. Additional erosion control measures include the maintenance and repair of road shoulders, and the installation of riprap on headwalls and ditches where erosion is a problem. Pesticides are required to be handled, stored and applied in such a way as to minimize environmental damage. The plan also specifies the proper uses of and the required quantities of fertilizers, insecticides and herbicides.

The installation with the most comprehensive nonpoint source abatement plan for this MAJCOM was summarized in a "Talking Paper." This installation had abatement measures in all applicable areas. Potential sources of nonpoint source pollution were identified as runoff from parking lots, from and along access roads, from construction sites, and from the use of fertilizers. Paved surfaces are swept at least every two weeks, with the frequency increasing after sanding in the winter. Erosion control structures are in place along the main access road. Areas susceptible to erosion are reseeded on a routine basis. Contract specifications require contractors to use good "housekeeping" practices to minimize pollution. Fertilizers are only used in small quantities required to establish new plantings.

Also included in the MAJCOM #4 informational response was a state report assessing best management practices for stormwater management.

The discussion concerning this report is included in the section titled "Installation Improvement", beginning on page 56 of this text.

MAJCOM #5. The installations in MAJCOM #5 contain a wide range in implementing nonpoint source abatement procedures. The range for overall implementation is from 25 to 100 percent. Unlike the other MAJCOMs discussed earlier, almost half (44 percent) of these installations have nonpoint source abatement in one area and 75 percent have implementation levels of 50 percent. Table 8 below summarizes the implementation level for each of the five nonpoint source pollution abatement categories.

Table 8  
MAJCOM #5 Summary

Category	Implementation Level
Agriculture	69
Urban	19
Construction	13
Silvaculture	100
Other	88

The data suggests, just as with three of the four MAJCOMs discussed previously, that MAJCOM #5 has not implemented urban nonpoint source abatement. There appears to be three exceptions to this. Two installations use street sweeping, while the third has qualified individuals do all fertilizer application (including Military Family Housing areas). This practice eliminates the opportunity for untrained

individuals to wrongly apply fertilizer, greatly decreasing the likelihood that the fertilizer will end up in surface water.

Additionally, the data suggests that construction nonpoint source abatement procedures have not been adequately implemented. It is only documented at one installation that contractors are required, through a provision in all construction contracts, to remove any sediment associated with their project. Nowhere in the data is there evidence that contractors are required to take any other actions to prevent construction nonpoint source pollution.

Several of the installations in MAJCOM #5 use oil/water separators to treat runoff from aircraft maintenance areas. The effluent is then passed to the sanitary sewage system for treatment. Not only can this be expensive if the treatment plant is not Air Force owned, it can cause significant problems during heavy storm events. A less expensive alternative is in use at three of the installations. Absorbent booms are placed in storm water drainage ditches to collect any petroleum products. The rational and specific function for using these absorbent booms was not included in the informational response.

This use of absorbent booms as a primary means for capturing pollutants is controversial at best. This is adequate when these pollutants are intermittent. However, oil/water separators are more appropriate when pollutant loadings are consistently high.

In response to the informational request, MAJCOM #5 provided their command outline for Land Management and Grazing & Cropland Plans. The Land Management Plan outline contained an environmental provision designed to protect the air, water and land. However, nonpoint source

pollutants were not addressed. The Grazing & Cropland Plan outline did not contain any environmental protection provisions.

Point papers on Clean Water Act compliance status were obtained on most of the installations within MAJCOM #5. The information reflected in these point papers was supplemental to that information reflected in the official MAJCOM response, the response from HQ USAF/LEEVN, and the HQ USAF/LEEVN response. There are three installations at which nonpoint source pollution is currently a problem.

At the first installation, stormwater contains untreated runoff from several industrial processes. This runoff comes from 50 percent of the flightline and is treated by oil/water separators prior to discharge. Both the EPA and the state Department of Environmental Quality have told the installation to cease industrial discharges into stormwater flows. This could not be done without impacting the installation's mission. A study is currently underway to determine the necessary procedural changes necessary to eliminate this problem.

At another installation, the provisions of the NPDES permit are not being met in several ways. One violation, relevant to this research effort, is for the failure to develop a nonpoint source pollution control program. One purpose of a \$50,000 study, scheduled to be completed in June 1990, was to identify and record all pollutant types, sources (both point and nonpoint), quantities, and pathways the pollutants follow within the installation boundaries. This information would then be used to formulate a nonpoint source pollution control program.

A third installation is anticipating future regulatory requirements from draft EPA regulations. Stormwater which has come in contact with industrial areas that use hydraulic fluids, oils and fuels will probably have to be rerouted to a pretreatment plant prior to discharge into the local wastewater treatment plant. This installation has not initiated any official action pending the publication of the regulatory requirements.

MAJCOM #6. The implementation for the installations in MAJCOM #6 ranges from 50 to 75 percent. Table 9 below summarizes the implementation level for each of the five nonpoint source pollution abatement categories. The data suggests that MAJCOM #6 has implemented nonpoint source abatement procedures in all areas except for urban nonpoint source pollution abatement. The one exception to this was the documented use of street sweeping to minimize particulates in storm water runoff.

Table 9  
MAJCOM #6 Summary

Category	Implementation Level
Agriculture	60
Urban	20
Construction	60
Silviculture	NA
Other	80

In response to the request for information, MAJCOM #6 provided their own list of best management practices for nonpoint source pollution abatement. This information was surprisingly absent from every other MAJCOM response. These best management practices stress that nonstructural nonpoint source pollution management practices can effectively solve most nonpoint source pollution problems.

Nonstructural management practices are those means of mitigating nonpoint source pollution which do not require any construction to implement. These practices include:

- 1) Effective spill prevention and response planning;
- 2) Effective spill response implementation;
- 3) Proper storage, handling, and application of pesticides;
- 4) Proper selection and application of fertilizers;
- 5) Preparation of high quality construction site erosion control and stabilization plans;
- 6) Effective construction inspection and enforcement (for erosion control; and
- 7) Control of off-road vehicle use and heavy equipment parking areas.

In some cases, MAJCOM #6 points out that structural methods may be required. Structural abatement methods rely on physical means to trap, separate or impede pollutants from entering surface waters with storm water runoff. If this is necessary, the following low-cost methods are recommended:

- 1) Absorbent booms (as compared to oil/water separators in controlling oil or fuel wastes);
- 2) Construction of water bars on roads;
- 3) Small sedimentation ponds or sediment traps with perforated standpipes;

- 4) Fabric fences to control erosion;
- 5) Straw-bale dikes to control erosion; and
- 6) Other specialized erosion control procedures such as erosion control netting, mulching, and hydramulching.

Additional methods to be included in best management plans are:

- 1) Clean culverts and sewers, and sweep streets to reduce sediment and debris from urban areas;
- 2) Repair decayed pavements and restabilize shoulders;
- 3) Include the use of minimum tillage practices, planting with contours, building of terraces, and construction of grass waterways in agricultural outleases; and
- 4) Control runoff of nutrients from around horse stables by not piling or storing manure.

MAJCOM #6 also appears to be the only MAJCOM which has coordinated their efforts with at least one AFRCE. This coordination is reflected in the MAJCOM nonpoint source pollution policy. This policy closely follows the Air Force Policy with the addition of the AFRCE management strategies. A discussion of these AFRCE management strategies can be found on page 52.

MAJCOM #7. The data was incomplete for MAJCOM #7. The only available information concerned the use of best management practices to limit nonpoint source pollution. The specific nature of these practices was not specified. This MAJCOM did not have an adequate number of installations represented in the data for any generalizations to be made on command-wide implementation.

MAJCOM #8. The data was also incomplete at MAJCOM #8. The only available data points to the use of good "housekeeping" practices to improve the quality of storm water runoff from pavement surfaces at one installation. These practices are in direct response to a NPDES

violation for discharge of oil/grease to surface waters. Since no other nonpoint source pollution data was available on other installations within this MAJCOM, generalizations could not be made on this command.

MAJCOM #9. The installations in MAJCOM #9 that are represented in the data had 100 percent implementation of the applicable nonpoint source pollution abatement categories. Table 10 on the next page summarizes this. However, there was not an adequate number of installations represented in the data for any generalizations to be made concerning command-wide implementation.

Included in the response to the informational request were applicable excerpts from the installations' Land Management Plans. These excerpts indicated that environmental protection was very important. However, it was only the most recent Land Management Plan excerpt which contained a paragraph that specifically addressed the control of nonpoint source pollution through the use of best management practices. Unfortunately, the attachment listing those best management practices was not provided for analysis.

Table 10

**MAJCOM #9 Summary**

Category	Implementation Level
Agriculture	NA
Urban	100
Construction	100
Silvaculture	NA
Other	100

MAJCOM #10. The information that was forwarded by MAJCOM #10 precluded the use of the five nonpoint source pollution categories. However, the information which was provided has resulted in the following observations. MAJCOM #10 does not appear to have a nonpoint source abatement program as such. They stated that their

...bases do not have a nonpoint source pollution problem. All runoff is collected by storm drains or perimeter ditches. Discharge points are either currently permitted or in the process of being permitted.

MAJCOM #10's inaction to implement nonpoint source abatement procedures is due to their admission that

the EPA and state regulators have special emphasis on specific areas of national river drainage basins and are more restrictive on discharges in these areas. No...bases have discharges into any of these areas.

#### AFRCE Implementation

The purpose of the second investigative question was to determine if Air Force Regional Civil Engineers (AFRCEs) are adequately providing coordination for the Air Force with state and regional agencies. This coordination requirement is set forth by the Air Force policy discussed in Chapter 2, beginning on page 18. To determine how well the AFRCEs are providing this coordination, the AFRCE responses were qualitatively analyzed.

Two of the three AFRCE regions responded to the request for information. Consequently, only those two organizations can be discussed. No inferences or generalizations can be made about the third one. Neither of the responding AFRCEs will be identified by name to protect their anonymity.

The content of the AFRCE responses did not contain the data concerning the state and regional laws that were originally desired. However, there were several points of interest that can be addressed.

The first AFRCE replied to the informational request by stating that "a review of our existing state regulations file indicates that we may not have the most recent information." They then stated that they were contacting the states within their region requesting the latest rules and regulations on nonpoint source abatement be forwarded to both their office and that of the researcher. At the time of this writing, none of the information has been received.

The second AFRCE provided some limited information concerning their actions and position concerning nonpoint source pollution. Individual states within this region were first contacted in January 1988 while the states were conducting nonpoint source pollution surveys. The data from these surveys was compiled into the state's Best Management Plan (BMP). The response goes on to say that most of the state BMPs are on file at their office. This information was not forwarded for analysis due to the lengthy nature of the BMPs and the limited reproduction capability of the AFRCE. A list of the appropriate state agencies was provided to facilitate obtaining these BMPs. Due to the time limitations placed on this study, no attempt was made to obtain these BMPs.

A brief analysis of the data forwarded by the AFRCE on the state BMPs provided some interesting information. Many of the state plans reference Air Force Land Management Plans, Grazing and Cropland Plans, and Forestry Management Plans. It is noted that the states have not contacted the Air Force during this planning process. For this reason,

contacted the Air Force during this planning process. For this reason, this AFRCE has not filed any data on specific abatement actions.

As noted previously in the subsection titled "MAJCOM #6", one MAJCOM informational response included a nonpoint source pollution policy that included this second AFRCE's compliance strategy. The management strategies which were developed to support the Air Force policy responsibilities are listed below:

1. Reviewing AFRCE's planning, policy, operations and maintenance, and construction activities to assure nonpoint source pollution is included.
2. Conducting meetings and workshops with state, federal, and regional agencies to discuss state information requirements.
3. Maintaining an up-to-date file of each state's nonpoint source pollution standards and regulations.
4. Coordinating the nonpoint source pollution information between the MAJCOM's, bases and states.
5. Providing the bases with up to date information on nonpoint source pollution control requirements.

From the earlier discussion, it would appear that this second AFRCE has implemented these management strategies.

#### Installation Implementation

The purpose of the third investigative question was to determine if Air Force installations have implemented nonpoint source pollution abatement procedures. The compiled data shows that the overall implementation level for the 72 installations is approximately 50 percent. This figure would seem to indicate that Air Force installations are not adequately addressing this issue. However, the diverse, somewhat ambiguous and mostly incomplete installation

information cannot be correlated accurately with state regulatory requirements.

Originally, information on state regulatory requirements was to have been provided by the AFRCEs. Verification would then be made using the Computer-aided Environmental Legislative Technical Information System (CELDS) database located in the Environmental Technical Information System (ETIS). ETIS was developed jointly by the Army Corps of Engineers and the University of Illinois and is currently maintained by the latter at the University of Illinois at Urbana-Champaign. However, since the AFRCEs did not provide the data on state regulatory requirements, the CELDS database was accessed to determine if the installations have implemented nonpoint source pollution abatement procedures for compliance with state regulatory requirements. In some cases, the lack of information in CELDS was not corroborated with information obtained in the literature review. This made any comparisons of installation implementation to state regulatory requirements suspect at best.

ECAMP reports also provided a means of measuring installation compliance to nonpoint source pollution regulatory requirements. Unfortunately, only six ECAMP excerpts were provided for analysis, three each from two different MAJCOMs. The analysis and comparison of these six excerpts to state regulatory requirements was determined by the researcher as being too small a sample for generalizations to be made concerning implementation Air Force wide. However, a limited discussion of the contents of the excerpts follows.

MAJCOM #6 is one of only two MAJCOMs to include any ECAMP excerpts. Two of the MAJCOM #6 excerpts were in draft form, while a third had been finalized. At one installation, it was reported that little progress had been made on nonpoint source abatement planning. However, this installation has received guidance and attended a state meeting on nonpoint source pollution abatement planning. At another installation, the ECAMP report also notes that the installation has not implemented a nonpoint source pollution control program. As of 4 January 1988, the installation had only identified on-base categories of nonpoint source pollution. The third ECAMP report notes that the nonpoint source pollution program is not being enforced. This report specifically cites the lack of enforcement of construction management practices.

Also included in the data was three ECAMP excerpts from MAJCOM #9. One installation was identified as requiring modifications in various locations to prevent petroleum products from entering surface waters. These needed modifications included the installation of curbing around JP-4 fill stands to contain inadvertent discharges, and the relocation of hazardous material/waste storage areas to a covered location. Additionally, it was recommended that the Base Civil Engineers develop and implement a storm water surveillance program to satisfy the requirements set forth by Air Force Regulation 19-7, "Environmental Pollution Monitoring". Also noted in this excerpt was the use of absorbent material in retention ponds to collect petroleum products and chemicals. This ECAMP excerpt was dated January 1990.

The second MAJCOM #9 ECAMP excerpt noted that storm water from the "major POL storage and handling areas" is passed through oil/water

separators prior to its discharge off base. At the time of this report (7 Sep 88), the installation was on the verge of implementing the quarterly monitoring of storm water discharges.

The third ECAMP report from MAJCOM #9 showed that the installation places high emphasis on the use of oil/water separators. It is noted that the outdoor aircraft wash rack system is equipped with a storm water discharge bypass to allow direct discharge of run-off when the wash rack is not in service. This discharge is not currently being monitored. Also, this report notes that no nonpoint source abatement procedures are currently being used on the run-off from the POL tank farm. As a result, it was noted that the storm water channels adjacent to the discharge points were stained and an oily sheen could be observed. Finally, the report notes that the ammonia-nitrogen discharge limits have not consistently been met during the winter months. This seasonal variation has been attributed to the use of urea to deice the taxiways in the winter.

Of the twenty installations that have been identified by HQ USAF/LEEVC as violating Clean Water Act provisions, only at three installations can nonpoint source pollution be partially attributed for the violation. At the first installation, major portions of the flight line have extensive storm water drainage systems which are not treated prior to discharge from the base. Consequently, the installation has been cited for discharging hazardous wastes.

The second installation is violating its NPDES permit for surfactants. The surfactants enter the storm water system in runoff from aircraft maintenance areas. The occasional foaming has been

installation, a foam has been observed in the effluent from its waste water lagoon. The other installation has not consistently met its discharge limits for ammonia-nitrogen during the winter months. The cause for both have been attributed to the use of urea. Since this installation also uses deicing fluids and urea, the foam could easily be attributed to those substances.

The third installation is discharging oil/grease in concentrations higher than its NPDES permit allows. This installation is using good "housekeeping" to remediate the situation. None of the other installations appear to be in violation of any state regulatory requirements due to nonpoint source pollution.

Generalizations about other Air Force installations cannot be made from an analysis of the existing database. Therefore, a determination as to whether Air Force installations have implemented nonpoint source pollution abatement procedures remains inconclusive.

#### Implementation Improvement

The purpose of the fourth investigative question was to determine what can be done to improve implementation of nonpoint source pollution abatement at Air Force installations. As indicated in the preceding section, Air Force installations are effectively addressing those nonpoint source pollution areas which are relevant to the states. However, there are several ways that the installations can ensure that this continues to be the case.

One the most significant abatement measures that can be implemented is educating the installation populace. Environmental awareness has already led to significant increases in the use of car pools and

recycling (to just name two). Installation employees and residents must be aware of their actions that are polluting the environment. Nonpoint source pollution is only a small portion of this. It is significant that education was only once mentioned as a method to abate nonpoint source pollution.

Installation education plans should focus on abating urban sources of nonpoint pollution, since the installation populace has little direct impact on the other areas. Specifically, the role that good "housekeeping" practices play in pollution abatement must be addressed. Removal of debris from Military Family Housing, common use areas such as parks and playgrounds, and other non-industrial areas needs to be the responsibility of every individual. For example, amateur mechanics need to know of the proper procedures for disposing of used motor oil and old cleaning solvents. Without the support of the installation populace, an abatement plan will not work.

It must be noted that the use of street sweeping, by itself, is of little value. One state's assessment report cited a December 1983 EPA report titled "Results of the Nationwide Urban Runoff Program: Volume 1 - Final Report" which noted that street sweeping will remove coarse sediments and litter, but it has limited ability to remove fine sediments and dissolved pollutants. The EPA concluded that a street sweeping frequency of every two days, using vacuum-type sweepers, has the potential of reducing the pollutant load between two to five percent. The state questioned the marginal benefit of this approach and recommended that large cities use street sweeping at a frequency of three to six times a year to reduce the amount of litter, trash and

debris entering surface waters.

The most significant pollution sources on an installation are its industrial areas. Specifically, the data suggests that the runway, taxiways and aircraft maintenance areas are the largest contributors of nonpoint source pollutants. These pollutants include deicing fluids, urea, petroleum products and other miscellaneous substances. Most installations have elaborate practices to clean-up any fuel or oil spill. Good housekeeping practices can account for the majority of the miscellaneous substances. Employees must know why they should not throw solvents out the back door and why they should deice airplanes in a manner that allows waste water to be properly collected (instead of just running off the paved surface). Substances, such as urea, herbicides and pesticides, need to be used in the smallest amounts possible to accomplish the task.

Elaborate structural devices such as oil/water separators do not appear to work well at several installations. The cause or causes of this poor performance was not included in any of the informational requests and could range from lack of maintenance to design flaws. Whatever the cause is, it appears that this has led to several installations installing absorbent material across drainage ditches to absorb petroleum products. These absorbent booms are becoming increasingly popular due to their relatively low initial cost. One company was found which claimed that its absorbent boom was highly effective for absorbing petroleum based hydrocarbons, solvents and PCBs (Hoff, 1990: Atch 1). Unfortunately, no data could be found to verify their effectiveness in reducing the amount of deicing fluids (and other

nonpoint source pollutants) discharged in storm water runoff.

The Air Force Engineering and Services Center is currently researching alternatives for urea that are less harmful to the environment. The interim solution is to use mechanical means such as plows, brooms and underbody ice scrapers as the primary means of removing ice from runways and taxiways (HQ AFESC, 1990). At best, a urea substitute is probably several years away.

Nonstructural best management practices are a must, especially due to the limited furling within today's Air Force. Generally, these practices ensure the proper storage, handling, and application of pesticides, fertilizers, herbicides and insecticides, and the timely reporting and cleanup of spilled hazardous materials. Additionally, quality construction site erosion control and stabilization plans must be used, and off-road vehicle use and heavy equipment parking areas should be strictly controlled.

One of the most useful ways to limit construction nonpoint source pollution is through the use and enforcement of a contract clause. Several installations mentioned the use of such a clause, but an example was not included in any of the informational responses. This clause should include two key elements. The development of an erosion control plan, approved by the appropriate installation, regional, state and/or federal agencies. This plan should specify the use of sedimentation basins, straw bales, mulches, etc. Additionally, exposed soil should be minimized. Good "housekeeping" practices should be used to limit the litter, petroleum products, solvents, etc. that enter surface water. The effectiveness of this clause is dependent upon close monitoring by

the contract inspector and rigid enforcement by the contracting officer. Individuals filling either position need to be properly educated in this area prior to the use of such a clause.

#### Summary

The database that was compiled by this research consisted of 72 Air Force installations in ten MAJCOMs. These installations were located in 37 states. Table 1, on page 28, summarizes the number of installations per MAJCOM. Likewise, Table 2, on page 29, provides a summary by AFRCE. Table 2 also shows the number of installations located in a given state.

The purpose of the first investigative question was to determine if the MAJCOMs had implemented nonpoint source abatement measures at their installations. Of the seven MAJCOMs at which the sample size was large enough to make generalizations, six did not appear to have implemented a command-wide program to abate urban nonpoint source pollution. Installations which did show urban nonpoint source pollution abatement were mostly limited to the use of street sweeping to reduce the particulate matter from storm water runoff. One installation exclusively fertilizes all improved areas, including the Military Family Housing areas. The added expense for the installation may be worthwhile, especially in reducing high levels of nitrates in storm water runoff. Also, only two of the seven MAJCOMs did not show a command-wide abatement program for construction areas. Since most construction is accomplished by contract, it is fairly simple to develop and use a standardized clause to implement nonpoint source abatement in this area. Finally, it appears that all seven of these MAJCOMs have

and use a standardized clause to implement nonpoint source abatement in this area. Finally, it appears that all seven of these MAJCOMs have implemented both agricultural abatement and best management practices at the majority of their installations.

The purpose of the second investigative question was to determine if the AFRCEs are adequately providing coordination for the Air Force with state and regional agencies. Two of the three AFRCEs responded to the informational request. One of the responding AFRCEs stated that a review of their existing state regulatory files indicated that the file was out of date. The other responding AFRCE has been in contact with state regulatory agencies since January 1988. State regulatory data was not provided for analysis due to its voluminous nature. However, points of contact for the states were provided. This second AFRCE stated that, since the Air Force has yet to be contacted by any state concerning nonpoint source abatement, no specific abatement actions are on file. No generalizations cannot be made concerning the third AFRCE.

The purpose of the third investigative question was to determine if Air Force installations have implemented nonpoint source abatement procedures. The Computer-Aided Environmental Legislative Data System (CELDS) showed that, generally, each state approaches nonpoint source pollution abatement from a different perspective. At three installations, NPDES violations can be partially attributed to nonpoint source pollution. The first installation has been cited for discharging hazardous wastes in its storm water runoff. The second installation is discharging surfactants at levels higher than the NPDES permit allows. Occasional foaming has been attributed to deicing fluids and urea.

Other installations report similar occurrences of foaming in drainage ditch effluent but also report that the NPDES permit requirements are being met. The third installation is in violation of its NPDES permit for discharging excessive amounts of oil/grease. Unspecified best management practices are being used to correct the problem. The researcher was unable to adequately answer the question as to whether Air Force installations have adequately implemented nonpoint source abatement procedures.

The purpose of the last research question was to determine what measures can be taken to improve implementation of nonpoint source pollution abatement at Air Force installations. Education and nonstructural best management practices should be used first to mitigate nonpoint source pollution. The most significant source of nonpoint pollution appears to be the runway, taxiways and maintenance areas. Low cost structural abatement measures include the use of absorbent material across drainage ditches. The effectiveness of oil/water separators is questionable.

## V. Conclusions and Recommendations

### Overview

The purpose of this study was to evaluate the implementation of nonpoint source abatement at the Major Command (MAJCOM), Air Force Regional Civil Engineer (AFRCE) and installation levels. This chapter presents the conclusions and recommendations for further research based upon the results of this research effort.

### Conclusions

Research Question #1. MAJCOM implementation levels are presented in Tables 3 through 10. These implementation level percentages are intended to provide the reader with an approximation of the degree to which a given MAJCOM has implemented nonpoint source abatement at their installations. They are not intended for comparisons between MAJCOMs.

Generalizations were made on seven of the ten MAJCOMs that were analyzed. One MAJCOM has not implemented either urban or construction nonpoint source pollution abatement measures at a majority of its installations, while three other MAJCOMs have not implemented urban abatement measures. Two MAJCOMs have not implemented construction abatement measures at a majority of their respective installations. Only one MAJCOM was found to have implemented abatement measures in all areas at a majority of its installations. These implementation levels appear to indicate that nonpoint source pollution abatement measures have been implemented within these MAJCOMs.

Since less than half of their respective installations were represented in the data, generalizations were not made for three other

MAJCOMs. However, significant information was available on two of these MAJCOMs to make some specific observations. At the first MAJCOM, nonpoint source pollution abatement appeared to be implemented in every applicable category at all three of the installations represented in the data. This was the only MAJCOM for which this was observed.

Conversely, an unsettling statement was made by another MAJCOM. This MAJCOM assumes that, so long as a nonpoint source pollution discharge is permitted, there is not any need to implement any abatement practices. This philosophy does not begin to address mitigating nonpoint source pollution itself. Nonpoint source pollution will continue to be prevalent. At permitted discharge points, limited available resources will be continually applied towards mitigating the effects of nonpoint source pollutants. This inaction to implement abatement practices can be partially attributed to this MAJCOM's statement that only certain specific river drainage basins were receiving emphasis from the EPA and state regulators and that none of this MAJCOM's installations were discharging into these areas. This philosophy must be changed before the regulators change their focus onto areas in which this MAJCOM's installations are discharging nonpoint source pollutants.

Research Question #2. Two of the three AFRCE regions were analyzed to determine if they were providing adequate coordination for the Air Force with state and federal agencies. Only for one AFRCE did this appear to be the case. The other AFRCE admitted that they did not possess the current state regulatory requirements. Thus, there appeared to be a lack of current coordination with state regulatory agencies. No generalizations could be made about the third AFRCE.

Research Question #3. Due to the diverse, somewhat ambiguous and mostly incomplete information available on individual installations, generalizations could not be made about installation implementation of nonpoint source pollution abatement measures, especially since every state has a separate, unique manner of addressing nonpoint source pollution abatement. However, it seems that the one area on most installations which poses the highest threat for contributing to nonpoint source pollution is the industrial complex supporting aircraft operations. Added emphasis needs to be placed in mitigating nonpoint source pollution from this area.

Research Question #4. Installations can greatly improve their implementation of nonpoint source pollution abatement measures. Management practices which do not require construction of such things as oil/water separators and settling ponds should be implemented first. These practices are aimed at reducing nonpoint source pollution by curtailing it at its point of origin. Every installation should ensure that their employees and residents are adequately educated about nonpoint source pollution and its abatement. Nonstructural best management practices which ensure the proper storage, handling and application of pesticides, fertilizers, herbicides and insecticides must be refined to ensure that minimum amounts are used at the optimal times. This will reduce both nonpoint source pollution and the costs associated with applying these compounds. Construction contracts should include provisions to limit erosion and other nonpoint source pollution generated at construction sites. Contractors should then be closely monitored to ensure compliance to these contractual requirements.

Structural management practices should only be used after the above management practices have been implemented, since structural practices only correct the symptoms of nonpoint source pollution, not mitigate it at its point of origin.

Recommendations for Further Research

This research effort was initiated to determine the degree of nonpoint source pollution abatement measures at three different Air Force levels: MAJCOMs, AFRCEs, and installations. Since difficulties were encountered obtaining relevant data by which to evaluate installation implementation, further research is needed for such an evaluation to be made.

First, a comprehensive database showing the relevant state and regional regulatory requirements must be established. This database must be compiled from direct contact with the state and regional agencies. The AFRCEs are the appropriate agencies to accomplish this.

Then, data on the installations can be obtained in one of two ways. The most current information on abatement practices should be obtained directly from the installations. However, high workloads at the installation level could cause this information to be degraded. If this is the case, then Environmental Compliance Assessment and Management Program (ECAMP) reports might be the answer. Since environmental compliance evaluation is a stated purpose of the ECAMP process, the reports detail violations to state and/or regional regulatory requirements and list the corrective actions required to remedy the situation. Final copies of ECAMP reports are publicly available. It may be possible to solicit MAJCOMs, with HQ USAF/LEEV approval, for

draft ECAMP reports where final copies are not available. This approval is necessary, since draft ECAMP reports are classified "For Official Use Only" and will not normally be publicly released until after the final report is prepared.

The focus of this subsequent analysis should not be to determine compliance with an Air Force policy or regulation. Instead, it should compare current installation implementation of nonpoint source abatement measures with the actual federal, state and regional regulatory requirements. It is only in this way that a determination can be made as to the degree to which Air Force installations have implemented nonpoint source abatement measures. This determination is necessary to ensure that noncompliance to nonpoint source pollution regulatory requirements does not adversely affect an installation's mission.

**Appendix A: Informational Request to HQ USAF/LEEVC**

FROM: AFIT/DEM

12 Mar 90

SUBJECT: Research of Nonpoint Source Pollution Abatement in the Air Force

TO: HQ USAF/LEEVC (Mr. Jayant Shah)

1. Thesis research at the Air Force Institute of Technology is currently being conducted on nonpoint source pollution abatement in the Air Force. I solicit your cooperation to contribute data necessary to the subject research.
2. Per your phone conversation with Capt Terry Seaman, I am requesting that you forward a copy of the background papers that you have compiled concerning Clean Water Act (CWA) compliance at Air Force installations (ref your msg dtd 141930Z Dec 89, CWA Compliance at Major Wastewater Discharging Installations).
3. Your timely support is greatly appreciated. All organizations will have complete anonymity throughout the thesis process, including the final report. Upon completion, the results and recommendations of this research will be available upon request from AFIT.
4. For more information concerning this request, please call Capt Seaman at AUTOVON 785-5435. Please forward your input via official distribution to:

Capt Terry G. Seaman  
AFIT/LSG  
WPAFB OH 45433-6583

MARK N. GOLTZ, Lt Col, USAF  
Head, Dept of Management Applications  
School of Civil Engineering  
and Services

**Appendix B: MAJCOM and AFRCE Informational Request**

FROM: AFIT/DEM

19 Apr 90

SUBJECT: Research of Nonpoint Source Pollution Abatement in the Air Force

TO:

1. Thesis research at the Air Force Institute of Technology (AFIT) is currently being conducted on nonpoint source pollution abatement in the Air Force. This research is focusing on what is currently being done at Air Force installations and what the various state agencies are mandating. One result of this research will be to crossfeed information on nonpoint source pollution management which is ongoing at Air Force installations. I solicit your cooperation to contribute data necessary for this research.
2. Your assistance is needed in consolidating information on nonpoint source abatement practices and state environmental laws which specifically address this subject. Currently, this information is fragmented and has been difficult to locate. The list below contains several items that have been identified as sources of nonpoint source abatement information. Any other applicable information or comments you may have are also welcome. As a minimum, please forward copies or applicable document excerpts on the following:
  - a) Natural Resource Protection Plans such as
    - (1) Land Management Plan
    - (2) Grazing and Cropland Plan
    - (3) Forestry Management Plan
  - b) Information that you possess concerning state laws relevant to this subject matter.
  - c) Information on Best Management Practices (BMPs) or specific abatement actions currently implemented at your installations.
  - d) Excerpts from any report such as the Environmental Compliance Assessment and Management Program (ECAMP) which is relevant to this subject matter.
  - e) The name and telephone number for a point of contact for your organization.
3. We request that your inputs arrive by 30 May 1990 for inclusion in our research results. All organizations will have complete anonymity throughout the thesis process, including the final report. Upon completion, the results and recommendations of this research will be available upon request from AFIT.

4. For more information concerning this request, please call Capt Terry Seaman at AUTOVON 785-8989. Please forward your input to:

Capt Terry Seaman  
AFIT/LSG  
WPAFB OH 45433-6583

5. We greatly appreciate your efforts to further research on this important environmental issue. Our results will produce useful management guidance for use by your respective installations. Again, I thank you for your time.

MARK N. GOLTZ, Lt Col, USAF  
Head, Dept of Management Applications  
School of Civil Engineering and Services

**Appendix C: MAJCOM and AFRCE Distribution List**

The following is a list of the MAJCOMs and AFRCEs who were mailed the letter appearing in Appendix B. The addresses are included to aid subsequent research. Supplemental information on these and other MAJCOMs was made available by both HQ USAF/LEEVC and HQ USAF/LEEVN.

**AFRCE-WR/ROV**  
630 Sansome St., Rm 1316  
San Francisco, CA 94111-2278

**AFRCE-CR/ROV**  
1114 Commerce St., Suite 206  
Dallas, TX 75242

**AFRCE-ER/ROV**  
77 Forsyth Street, SW  
Atlanta, GA 30335-6801

**HQ AFLC/DEV**  
Wright-Patterson AFB, OH 45433-5001

**HQ AFRES/DEPV**  
Robins AFB, GA 31098-6001

**HQ AFSC/DEV**  
Andrews AFB, MD 20334-5000

**ANGSC/DEV**  
Andrews AFB, MD 20331-6008

**HQ ATC/DEEV**  
Randolph AFB, TX 78150

**HQ MAC/DEEV**  
Scott AFB, IL 62225-5001

**HQ SAC/DEV**  
Offutt AFB, NE 68113-5001

**HQ AF SPACECOM/DEPV**  
Peterson AFB, CO 80914-5001

**HQ TAC/DEEV**  
Langley AFB, VA 23665

**Appendix D: List of Respondents to Informational Requests**

The following is a list of the organizations who responded to requests for information.

Air Force Logistics Command (AFLC)

Air Force Regional Civil Engineer - Central Region (AFRCE-CR)

Air Force Regional Civil Engineer - Eastern Region (AFRCE-ER)

Air Force Reserve (AFRES)

Air Force Systems Command (AFSC)

Air Force Space Command (SPACECOM)

Air Training Command (ATC)

Military Airlift Command (MAC)

Tactical Air Command (TAC)

HQ USAF/LEEVC

HQ USAF/LEEVN

**Appendix E: Nonpoint Source Pollution Points of Contact**

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AV 787-5879

Toni Beasley  
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Robins AFB, GA 31098-6001  
AV 468-5598

Colonel Martin Byrne  
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Ms Hopper  
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Scott AFB, IL 62225-5001  
AV 576-5763

Mr. Jonathan Kajiwara  
HQ PACAF/DEMM  
Hickam AFB, HI 96853-5001  
DSN 449-9824

Mr. Mick Sandine  
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AV 271-6324

**Mr. Brent Johnson**  
HQ TAC/DEVC  
**Langley AFB, VA 23665**  
**AV 574-4430**

**Mr. Jay Shah**  
HQ USAF/LEEVC  
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**AV 354-7788**

**Mr. Mark Decot**  
HQ USAF/LEEVN  
**Washington, DC 20332**  
**AV 297-3668**

#### **Appendix F: CELDS Search Summary**

The Computer-aided Environmental Legislative Data System (CELDS) database located in the Environmental Technical Information System (ETIS) provided much information on state regulatory requirements. The abstracts provided an insight to the widely varied approaches that are being taken by the states. Generally, no two states approach nonpoint source pollution abatement from the same perspective. To aid any subsequent attempts to expand upon this research, the 37 states relevant to this research effort are presented individually and in alphabetical order.

Alabama has placed its emphasis on protecting its coastal areas. Accession #4080, entitled "Permits and Requirements for Point and Non Point Sources in the Coastal Areas", requires permitting of "new nonpoint source construction in the coastal areas" which are larger than 25 acres. This regulation further states that an erosion plan which uses best management plans shall be submitted with the application.

Recommended best management practices to control erosion are

mulching; sodding; diversion berms; sedimentation catch basins; clean up practices; recreational area storage; diversion structures; aeration of soils; ponds; detention basins; porous pavements; holding tanks; infiltration systems; channel storage; minimize disturbed land area and duration of exposure to material elements; and return to natural vegetation.

Arkansas and Arizona both focus on protecting all waters within their boundaries through the use of general standards. Arkansas has published its "Surface Water Quality Standards" (found in accession #9554), while Arizona has its "Water Quality Standards" (found in accession #1617). Arkansas states that "all waters shall be free from

substances attributed to man-caused point or nonpoint source discharges in concentrations that produce undesirable" effects to aquatic life. The Arizona statement has only insignificant changes.

Accession #8070 provides the "General Surface Water Quality Standards" for the state of California. In short, California does not have any state-wide water quality standards. Local standards are developed and published by the nine Regional Water Quality Control Boards. No specific information in CELDS is given concerning the statutory requirements of these Boards.

A review of the CELDS database did not produce any applicable nonpoint source legislation for the state of Colorado. This is supported by the applicable MAJCOM response to the informational request. It stated that nonpoint source pollution legislation was expected September 1990.

Delaware, in "Permits for Discharges to Water" (found in accession #2634) does not require nonpoint source discharges to be permitted. Specifically, the following do not require a permit:

existing ditches to drain surface water runoff; surface water runoff; uncontaminated storm water discharge; plowing, cultivating or applying organic or inorganic fertilizers, herbicides, pesticides, and plant growth regulators for agricultural or horticultural purposes....

A review of the CELDS database did not produce any applicable nonpoint source legislation for the state of Florida. This lack of legislation is not supported by the literature review. Burden and Montgomery report that the 1987 Florida Surface Water Improvement and Management Act was passed to control nonpoint source pollution.

Amendments passed in 1989 were made to further mitigate phosphorus

effects (Burden and Montgamy, 1990: 15-16)..

Georgia also approaches this subject through the use of permits. Accession #846, "Discharge Permits for Sewage Treatment Facilities", states that any facility "discharging or proposing to discharge any pollutant from a non-point source" must "apply for a permit prior to discharging any pollutant" into state waters.

Accession #4492, "Marine Water: Classes AA and A; and Basic Criteria for All Waters", states that all Hawaiian waters shall be free from "controllable pollutions." These "controllable" nonpoint source pollutants are currently viewed as being the result of erosion.

Idaho applies its "General Water Quality Criteria" (accession #4947) to both surface and underground waters. This abstract states that Idaho waters, as a result of man-caused point or nonpoint source discharges, must not contain hazardous materials; deleterious materials; radioactivity; floating; suspended or submerged matter; excess nutrients; oxygen-demanding materials; or sediment.

Illinois approaches nonpoint source abatement in two different ways. First, in accession #2761 ("Permits for Construction and Operations of Treatment Works and Sewers and other Discharges not Required to have NPDES Permits, including Experimental Permits"), Illinois exempts construction permits for storm sewers that transport only land runoff. Then, in its "State Guidelines for Erosion and Sediment Control" (accession #5806), Illinois requires that each of its Soil and Water Conservation Districts develop a program and standards which follow specific guidelines. These standards must include soil loss standards for agricultural lands, stream banks, and non-

agricultural lands and construction sites. Additionally, enduring erosion and sediment control devices, structures and practices must be identified.

The only mention of nonpoint source pollution for the state of Indiana occurred in accession #1824, "National Pollutant Discharge Elimination System Permits". This abstract states that introduction of pollutants from nonpoint source agricultural and silvicultural activities are not required to be permitted.

In accession #8056, "Surface Quality Water Standards: General Provisions", any nonpoint source violation found by the Kansas Bureau of Water Protection requires suitable pollution control measures to be implemented. The obligation to design, build, or use the required or recommended pollution control structures or methods to control nonpoint source pollution shall not be removed by low flow, high flow, natural pollution or effluent-created flows.

Louisiana is another state which focuses on protecting its coastal zones. In accession #4822, "Permits for Coastal Use", both point and nonpoint waste water discharges are required to have a coastal use permit. Permits are not required for agricultural, forestry or aquaculture activities unless the discharges are into coastal waters or the existing water flow is significantly changed.

Maine approached nonpoint source abatement from several angles. Accession #6880, titled "Water Pollution Abatement Licenses: Variances", states that an erosion and sedimentation control plan will include "procedures to prevent water pollution from sediment...and fertilizers." Coastal wetlands are protected using "Coastal Wetlands:

Permits, Exemptions and Standards for Activities" (found in accession #5050). Wetland activities exempted from permit requirements include "minor repairs of structures requiring less than one cubic yard of material to be filled, dredged, or moved; (and the) repair of ways, roads, (and) railroad beds." Since 30 June 1984, the dumping of snow and attendant material that results from normal snow clean-ups is no longer exempted from permit requirements.

Several state agencies regulate nonpoint source pollution in Maryland. The Water Resources Administration of the Department of the Environment is responsible for the "Erosion and Sediment Control Regulations" (accession #3051). The abstract for this regulation states that an erosion and sedimentation plan is required for all of the following: "agricultural land management practices and the construction of agricultural structures"; construction of single-family dwellings; and "clearing and grading activities that disturb less than 5,000 square feet of land area and disturb less than 100 cubic yards of earth".

The Department of Health and Mental Hygiene of the Environmental Health Administration enforces "General Permits for Certain Classes of Discharges to State Waters" (accession #5720). Permits are required for storm water control systems and separate storm sewers. These systems shall be in accordance with grading and sediment control ordinances. Additionally, the erosion and sedimentation control plan is required to be approved by the local soil conservation district.

Finally, the Department of Natural Resources manages the "Stormwater Management Regulations" (accession #7218). These regulations are intended "to maintain, after development, the pre-

development runoff characteristics and to reduce stream channel erosion, pollution, siltation and sedimentation." The regulations do not apply to agricultural land.

Michigan takes a more simple approach to managing nonpoint source pollution. In accession #774, "Water Quality Standards -- Application and Exceptions", waters not meeting the applicable standards are required to be improved to meet those standards. If the failure to meet these standards results from natural causes or conditions, further reduction of water quality is prohibited by controllable point and nonpoint sources.

The only mention of nonpoint source pollution for the state of Missouri is listed in accession #4871, "Permits for Point Sources of Water Pollution". This abstract states that nonpoint source discharges are exempt from permit regulations.

According to accession #6167, "Land Use, Erosion and Flood Control", the state of Mississippi does not have any regulations governing land use, erosion or flood control. This file was last updated in February 1988.

Montana's focus is on protecting its surface waters. According to accession #2448, "Surface Water: Treatment Standards, Mixing Zones, Sampling Methods, and Radiological Criteria", the Environmental Sciences Division of the Water Quality Bureau has been empowered to mandate the elimination or minimization of storm drainage, storm sewer discharges, and nonpoint source pollution. Additionally, the dumping of snow from snow removal operations is prohibited unless it is authorized, in writing, by the above division.

The only mention of nonpoint source pollution for the state of Nebraska occurred in accession #4720, "NPDES Permits". This abstract states that agricultural and silvicultural nonpoint source discharges are not required to obtain a NPDES permit. No reference to other nonpoint source categories could be found in the CELDS database.

Accession #1043, "Design Criteria for Projects in Wetland Areas", is New Hampshire's attempt to protect its wetlands from construction siltation. When runoff from a construction site is expected to lower water quality standards, sedimentation shall be controlled through the use of dams of rocks and/or hay bales. Additionally, "rip-rap may be required at erodible locations." Finally, "all earth slopes shall be graded, mulched and seeded as soon as possible."

New Jersey, in accession 708 titled "Surface Water Quality: General Policies", mandates that all "activities resulting in the non-point discharge of nutrients shall implement best management practices to protect existing or designated uses" of that water. However, accession #5904, "NJPDES Permits for Discharges to Surface Waters", states that agricultural and silvicultural operations do not require a Discharges to Surface Waters Permit.

In New Mexico, voluntary best management practices are used in its statewide water quality management plan. This information was obtained from accession #1986, "Land Use and Erosion Control".

According to accession #8100, "Surface Water Quality: Standards for Interstate Waters and Water Quality Criteria for Specific Waters", Nevada focuses on setting water quality criteria at various control points. This criteria applies to all surface waters in the watershed

upstream from the control point to the next control point. Additionally, accession #8295, titled "Discharge Permit Requirements", excepts most agricultural and silvacultural operations from obtaining a permit. Nevada is the only state found to recognize that some agricultural and silvacultural operations may be a "significant contributor of pollution". These operations would then be required to obtain a permit.

A review of the CELDS database did not produce any applicable nonpoint source legislation for the state of New York. Essman points out that the state has given the authority to local governments to regulate land developers. Some of the local governments use zoning ordinances or construction regulation, while others operate on a voluntary basis (Essman, 1989:31). No specific information is available concerning these local regulations.

North Carolina is one of the many states which focus on mitigating nonpoint source pollution by controlling erosion and sedimentation. Legislation has been enacted to ensure that "Erosion and Sedimentation Control Plans" (accession #1019), which use "Erosion and Sedimentation Control Methods" (accession #1020), are developed to minimize erosion and sedimentation from any peak runoff rate from a ten-year frequency storm. These regulations further stipulate that a buffer zone must be provided around all lakes and streams. Additionally, the angle of graded slopes must not be too steep to not support vegetation or other erosion control devices. Agricultural and silvicultural lands are exceptions to the above. Accession #1021, "Sedimentation and Erosion Control: Responsibilities of Owners of Uncovered Land", mandates that

land owners of "all uncovered lands...which...exceed one contiguous acre...shall be provided with ground cover or other control devices."

According to accession #6985, "Regulations for Sedimentation and Erosion Control", North Dakota does not have any state-wide land use regulations. All land use regulations are formulated by the individual soil conservation districts. No information was available on these district regulations.

In accession #2389, "Surface Water Quality Standards: Criteria Applicable to All Waters", Ohio attempts to keep its water "free from materials entering the water as a result of human activity". For nonpoint sources of pollution, "feasible management or regulatory programs" will be used.

Ohio is the only state which is actively addressing urban nonpoint source pollution. "Urban Sediment Pollution Abatement Rules", found in accession #6729, require "the owner or person responsible for a development area" to develop an erosion and sediment control plan which identifies erosion problems and describes the measures used to alleviate them. This plan is required to be submitted to and approved by the Division of Water Quality Monitoring and Assessment of the Ohio Environmental Protection Agency prior to the initiation of any earth-moving activities. Accession #6730, "Urban Sediment Pollution Abatement: Standards and Procedures", describes the methods by which the erosion and sediment control plan should alleviate these problems. These methods include:

- 1) Sediment trapping practices,
- 2) Soil Stabilization of denuded areas within seven days if they will be dormant for over 45 days.

- 3) Processing concentrated storm water runoff from denuded areas through a settling facility.
- 4) Filtering or diverting sheet flow runoff through a settling facility.
- 5) Installing storm sewer inlets in such a manner that sediment-laden water will not enter the system.
- 6) Restabilizing stream beds and banks immediately after work completion.
- 7) Design and construct cut and fill slopes to minimize erosion.
- 8) Use permanent vegetative cover to stabilize the soil.

Oklahoma approaches nonpoint source pollution abatement through the use of permits. "Water Pollution Permit Requirements", found in accession #3987, describes the application requirements. These requirements include describing contaminated storm water disposal. Oklahoma exempts normal agricultural discharges which are directly into municipal treatment facilities. Facilities which generate waste from washing vehicles are required to be permitted.

Pennsylvania's "Surface Water Quality Standards", found in accession #1698, contains a generalized statement which addresses all water pollution. It states that "generally, water will not contain substances attributable to point or nonpoint source waste discharges in amounts sufficient to be harmful...." Specifically, Pennsylvania addresses "Erosion Control Plans and Measures" in accession #1709. This regulation was designed to "prevent water pollution by sedimentation and from fertilizers, pesticides, and other pollutants carried in sediment. It further states that all earth-moving activities must have erosion and sedimentation plans which are designed to implement and maintain the appropriate control measures and facilities. These control measures and

facilities are structural in nature.

South Carolina's "NPDES: Permit Requirements and Applications" (found in accession #5149) exempts storm sewers, which are separate from sanitary sewers or other sewers discharging waste water, from its permitting process. "Erosion and Sediment Reduction" (found in accession #7772) focuses on retaining sediment to the construction site. This is seconded by the "Standard Plan for Erosion, Sediment and Stormwater Runoff Control" regulation found in accession #8561. This latter regulation is significant in that

all construction plans prepared by or for the Department (Land Resources Conservation Commission) must include designs to manage stormwater runoff and control erosion and sedimentation using state-of-the-art practices.

Conservation districts administer South Dakota's "Soil Erosion and Sediment Damage Control" (found in accession #7284) program by acting on complaints which are submitted to them. The district supervisors, in cooperation and consultation with local governments, are required to comply with state guidelines in handling these complaints. No information was available on any specific regulations.

A review of the CELDS database did not produce any applicable nonpoint source legislation for the state of Texas. However, there are several files which are designed to protect various watersheds within the state. This selective approach is validated by one of the MAJCOM responses to the informational request.

Utah addresses nonpoint source pollution as a waste water. Accession #2049, "Waste Water Quality Standards and Water Uses Classification", states that "non-point waste sources are to be controlled through best management practices or regulatory programs."

Virginia is another state which only has "General Standards for Surface Waters" (found in accession #7129). This abstract states all state waters shall be free from substances which interfere directly or indirectly with reasonable, beneficial uses of water or which are harmful to human, animal, plant, or aquatic life.

The only mention of nonpoint source pollution for the state of Washington occurred in accession #1995, "Pesticide Handling, Use, Disposal and Holding". This regulation is aimed at protecting all state waters from the introduction of pesticides.

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# REPORT DOCUMENTATION PAGE

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